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Agroforestry

Working Trees for Islands

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***AGROFORESTRY HAS BEEN
IN USE IN THE PACIFIC AND
CARIBBEAN ISLANDS FOR
CENTURIES, WITH DIVERSE
AND WELL-DEVELOPED
MANAGEMENT SYSTEMS AND
MULTIPLE BENEFITS.***



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Like agroforestry systems elsewhere, island agroforestry intentionally integrates trees and crops. In both the Pacific and Caribbean islands, traditional agroforestry systems have been around for a long time, and they have evolved continually as new ideas about tree-crop relationships develop. They are an important part of the economic, social, cultural and ecological benefits of agriculture and forestry today. Many new residents and younger generations do not have a full appreciation of the richness of island agroforest resources and the depth of cultural knowledge of previous

generations in the Pacific and Caribbean islands.

Properly managed agroforests protect watersheds and are typically superior to tilled field agriculture in protecting soils from erosion. Because multistory agroforests have similar physical structure to natural forests, their multiple canopy layers and established root systems emulate natural forests in reducing the impact of rainfall on the soil and allowing water to seep into the ground.

Agroforests can enhance economic productivity by cash cropping and providing materials and experiences for island tourism

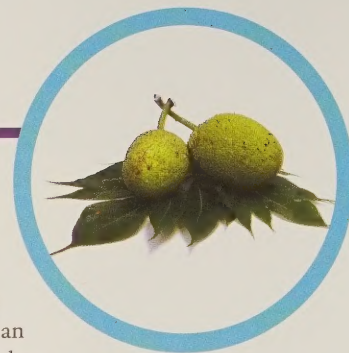
industries. The economic values of subsistence crops should be better recognized and quantified in terms of import substitution and cash-equivalence for family incomes.

Agroforestry also has social and cultural benefits; practicing agroforestry can help retain traditional ecological knowledge and cultural practices related to specific systems and species.

Working Trees means putting the right trees in the right places, and in the correct configuration to do a specific job. This brochure illustrates a variety of agroforestry systems in the Pacific and Caribbean islands and outlines many of their benefits.

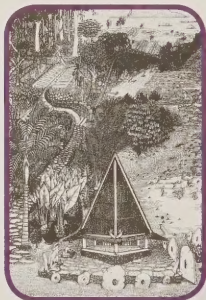
Home Gardens & Urban Agroforestry

[Lan ea binaw (Yapese)]



Food security and quality food products are a priority to island communities. Statistics show that people sometimes cannot afford to buy good quality food and instead consume cheaper or more convenient but unhealthy processed foods. This situation is more significant in some low income urban areas where people don't have access to fresh, quality, and affordable food. Public information campaigns have successfully raised awareness about the nutrition values of fresh produce, and have also appealed to cultural pride concerning traditional lifestyles, crops and recipes.

A line drawing depicting a Yapese agroforest landscape (Falanruw, 1994, drawing by Martin Faimau)



Home gardens

In tropical island communities, integration of edible gardens and fruit trees in residential backyards is part of the local culture. For centuries islanders have planted and maintained home gardens without calling them by that name. Planting fruit trees is one of the first things a homeowner does when moving into a new home. Local and traditional fruit trees used include mango, breadfruit, avocado, oranges, lemon, guava, loquat, currant, papaya, soursop, coconut, mountain apple, otaheite apple, and many others. Often under such trees or in a patch in the backyard there are tomatoes, eggplant, peppers, pumpkins, cabbage, bean, cucumber lettuce, and some herbs such as oregano, coriander, rosemary, basil, mint, and chives. Home garden agroforests produce fruit and vegetables for family consumption, and community residents enjoy the multiple benefits trees provide.

Urban Agroforestry

Urban agroforestry, combining agricultural and forestry practices on the same land in urban neighborhoods, should be considered as part of a solution to food security. This type of agroforestry may be an alternative for vacant lots that present high maintenance costs and safety issues to the government or communities. The keys to establishing community urban agroforestry projects are community empowerment and management by local community groups (villages, churches), with the support of the government and other entities. Community urban agroforestry signifies food security, fresh quality products, volunteer engagement, community well-being, and increased local income opportunities.



Shade Coffee

Coffee shrubs require certain environmental and ecological conditions to perform at their best in terms of vigor, growth and production. Shade coffee utilizes a combination of coffee shrubs and shade trees that form a secondary forest. Shade coffee production has been proven to provide environmental benefits such as soil erosion control, water quality and quantity improvement, and wildlife habitat. Shade coffee also provides socio-economic benefits such as the opportunity to develop other sustainable forest products and the reintroduction of traditional jobs

and cultural activities for local coffee pickers. Trees recreate favorable growing conditions such as maintaining ideal coffee-growing temperatures and reducing potential evapotranspiration by modifying solar radiation. The amount of light reaching the coffee understory can be managed by pruning shade trees. Most common shade tree species used in Puerto Rico include: *Inga vera* or guaba and *Andira inermis* or cabbage angelin. This secondary forest is also used to produce timber products and cut flowers such as heliconia.

Multistory Agroforestry

[Nien muhta/Inmwetak (Kosraen)]



Up to 65 percent of some Pacific high island forests and 85 percent of many atoll forests are agroforests containing a diverse mix of species, planted and carefully managed. What may appear as a natural forest to the untrained eye may actually be composed of many productive species which provide widely diverse products for subsistence or sale (fruits, tubers, spices, medicines, wood, and fiber) as well as important ecosystem services (soil protection, watershed function, and biodiversity) and traditional uses (foods for ceremonies or fibers, building materials for shelter, cultural ceremonial items (orator's staff, whisk, & necklace, kava bowls and cups), finemat, tapa cloth, handicrafts, and dyes for traditional dress).

Traditional

Traditional agroforesters know how to plant and care for each different species, taking into consideration the different amounts of light, moisture and nutrients available in different places when arranging mixed-species plantings. They also know how to manage the agroforest through phases of establishment, productivity and maturity of different species. Although originally for subsistence production, agroforests can be modified for commercial production without compromising the ecosystem services they provide. Species choice may be intertwined with land tenure considerations, as some tree species may mark land claims, or other species may be reserved for chiefs or others with harvesting rights.

Cash Cropping

Plantings of some traditional species such as coconut, kava, taros, or bananas have sometimes been intensified into monocrops for commercial production. These plantings can cause clearing of extensive areas of native forest (e.g. for kava or sakau in Pohnpei, or taro plantation in American Samoa and Samoa) or removal of large trees from agroforests to provide more growing space for cash crops. Resultant soil exposure can lead to increases in runoff and erosion. Ecosystem function may be reduced by loss of biodiversity. It is also possible to combine the traditional multistory approach with old or new crops to achieve a balance between watershed protection, subsistence needs, and cash crops.

“Multistory” means agroforests have multiple layers or tree canopy levels as in natural forests:



1

The **TALLEST TREES** may include breadfruit, coconut, mountain apple, otaheite apple, avocado, mango, betel nut, ylang-ylang, and various forest tree species.

2

UNDERSTORY TREES may include bananas, plantains, citrus, noni (nanu in Samoan), papaya, soursop, cocoa and beach hibiscus.

3

Yams, black pepper and other **VINES** grow up trees or trellises.

4

SHRUBS and **LARGE PLANTS** may include kava, taro, Xanthosoma, Alocasia, Cyrtosperma, edible hibiscus, and cassava, along with vegetables and medicinal herbs.

Coastal forests & windbreaks

[Gakiy qu mit ea laay (Yapese)]



Coastal Stabilization

The root network of the beach strand forest stabilizes the shoreline and minimizes erosion of the beach berm, reducing vulnerability to storm surges that threaten to remove soils and/or deposit salt water in coastal or atoll agroforests. Villagers and land-owners who “clean” away coastal forests and ground covers to create views and cooling breezes may unknowingly be exposing beach berms to erosion, and as a result, exposing interior agroforests to damage by salt inundation and salt spray.

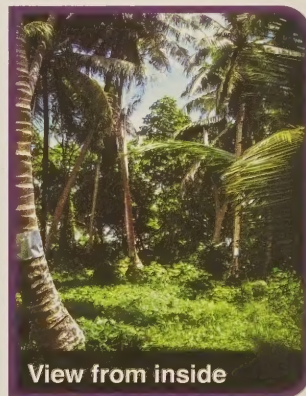
Coastal Windbreaks

Tropical islands are subject to strong winds and storms. As on the U.S. mainland, windbreaks may be planted to protect crops, orchards, pasture or forage, livestock or structures from the desiccating or mechanical impacts of wind. Island windbreaks commonly include species that provide secondary benefits such as fruit, mulch, fodder building materials, handicrafts, medicine and firewood.

Wind-borne salt spray poses specific challenges for coastal and atoll agroforests. Traditional practitioners recognize that the natural dense structure of trees, shrubs and vines in the coastal strand forest serves as a natural windbreak (near right) protecting the coconut plantation behind it (far right). Along calmer coastlines, mangroves (trees that grow below the high tide mark) also provide protection from wind.



View from shore



View from inside

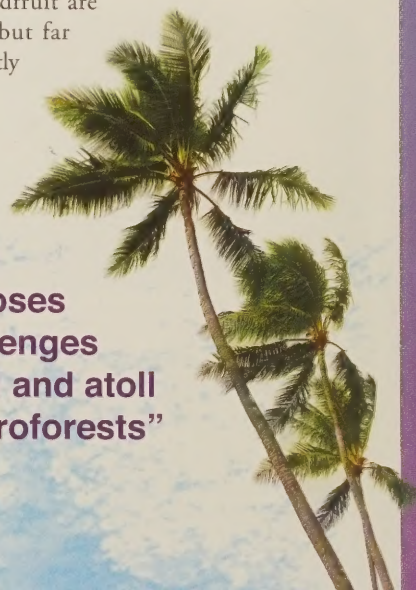


THIS ATOLL ISLET IS RINGED BY TREES PROVIDING SOME WINDBREAK PROTECTION TO THE INTERIOR TARO PADDIES; HOWEVER, THE COASTAL FOREST IS A RELATIVELY OPEN COCONUT PLANTATION RATHER THAN A DENSE STRAND FOREST. THE INTERIOR TARO PADDIES WOULD BE BETTER PROTECTED FROM WIND AND SALT SPRAY BY DENSER COASTAL WINDBREAKS.

Climate Change

The combination of rising sea levels, increased storm intensity, and possible decreases in rainfall is expected to affect atoll and coastal agroforests via erosion or increasingly brackish groundwater. Traditional species such as coconut, pandanus and breadfruit are vulnerable to these stresses but far better adapted than many recently introduced species.

**“Windborne
salt spray poses
specific challenges
for coastal and atoll
agroforests”**



Silvopasture in the Tropics

[Sistemas silvopastoriles en los Trópicos (Spanish)]

Combining trees and pasture production makes efficient use of space and natural resources to produce animal products as well as tree products. Silvopastures can also regenerate degraded lands that can result from previous monocultures in fields, grazed forests, and pastures and increase their biodiversity.

This regeneration can transform overgrazed forests by mixing in pasture species or by planting trees or shrubs into open pastures. The density of tropical silvopasture canopies are typically managed to provide adequate sunlight for the desired forage. Trees can provide nutritious leaves and fruits for forage, shade and shelter for livestock, and habitat for many wildlife species including pollinators. Silvopastures help create resilient landscapes by conserving soil humidity, reducing wind, improving water quality, and reducing soil erosion. Specific benefits of silvopasture trees include mitigating climate change by storing carbon, recycling nutrients from deeper layers of soil for use by plants and microorganisms nearer the soil surface and in the case of nitrogen fixing species, by adding nitrogen to the system.



Examples

of conservation practices applicable to silvopasture systems in the tropics.

Adding forage legume species to the paddock may increase feed protein to 20% or more.



SHADE TREES

Trees can be scattered throughout a pasture to provide shade. Strategically placed shade can promote more uniform grazing over the paddock. These trees can produce additional products such as timber, forage and fruits. Land managers need to practice thinning and brush management regularly to maintain forage quality.

LIVING FENCES

Living fences divide grazing paddocks or farm boundaries. They provide shade, shelter, fodder, and aesthetics. They also serve as ecological corridors. The most common species used in the Caribbean Area are *Gliricidia sepium* and *Guazuma ulmifolia*. When feed is scarce, trees can be pruned and serve as cut and carry.

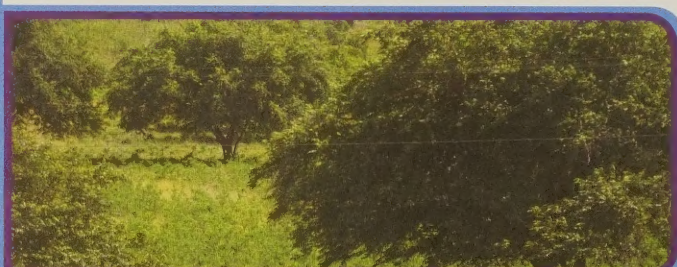


ALLEY CROPPING

This practice involves producing forage in alleys between rows of trees or shrubs. Trees and grasses may be browsed, foraged or used for cut and carry. This system may provide a balanced diet as cattle both browse legume trees and forage grasses. Plantations of coconut, African palm and citrus can be planted to create alleys that are managed for grazing.

PROTEIN BANKS

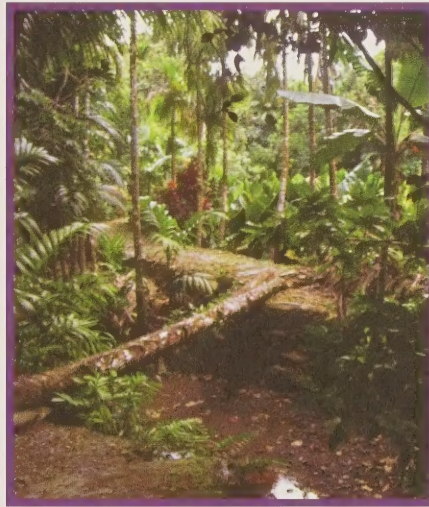
A protein bank is an area planted with high quality forage trees where livestock have limited access to browse for a few hours every one to three days. Protein banks are usually composed of a single species such as *Leucaena leucocephala* or *Cratylia argentea*. Pruning the trees and shrubs creates the growth of young tender shoots for the animals to browse.



Green Manure and Cut & Carry systems

[Mesei (Palauan), kalau (Pohnpeian), ma'a (Puluwat)]

Leaves of trees and shrubs improve soil quality with organic matter as they decompose. Traditionally, foliage from local non-nitrogen fixing species known to decompose readily was used in island agroforestry systems. Today, nitrogen-rich foliage of nitrogen-fixing species is often used, however many such species can naturalize readily and must be evaluated for invasive potential at the local level. Organic material from foliage is especially valuable for sandy atoll soils. "Cut and carry" systems mean foliage (especially from protein banks, previous page) is cut and carried to livestock. In the islands, pigs are more often fed from agroforest fruit and by-products such as coconut, copra cake, breadfruit, cassava, taro, Alocasia, Xanthosoma, Cyrtosperma, edible hibiscus, and banana waste.



Leaf Litter and Fallow

In the Pacific, *Hibiscus tiliaceus* and *Erythrina fusca* (in American Samoa and Samoa) is commonly planted into grassy areas as a fallow species that can out-compete the grass and enrich the soil with its foliage. It may then be thinned to make way for other crops, and maintained as a multipurpose understory species providing leaf litter in multistory agroforest.

Agroforestry in the landscape

Island landscapes commonly include a variety of agroforestry systems in suitable locations. Taro, Colocasia and Cyrtosperma (a staple starch) is often grown in small paddies along streams, behind dikes or streambanks reinforced with trees, mulched with Hibiscus, banana and coconut leaves. Paddies provide water storage and flood control services, and slopes are typically managed as agroforest, resulting in a productive yet protected watershed.

Compost and mulch

Tree and shrub foliage is also cut and used to create organic soils. For example, a pit may be excavated and filled with *Guettarda speciosa* and *Tournefortia argentea* leaves, and the resulting organic soil planted with taro and maintained with mulch and compost. Foliage may also be used to fill raised beds, as for bananas as shown.

Contact: USDA National Agroforestry Center, 402-437-5178 ext. 4011, fax 402-437-5712, 1945 N. 38th St., Lincoln, Nebraska 68583-0822. nac.unl.edu

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